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DWARF MISTLETOE AS A PREDISPOSING FACTOR FOR MOUNTAIN PINE BEETLE ATTACK OF PONDEROSA PINE IN THE COLORADO FRONT RANGE

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DWARF MISTLETOE AS A PREDISPOSING FACTOR FOR MOUNTAIN PINE BEETLE ATTACK OF PONDEROSA PINE IN THE COLORADO FRONT RANGE

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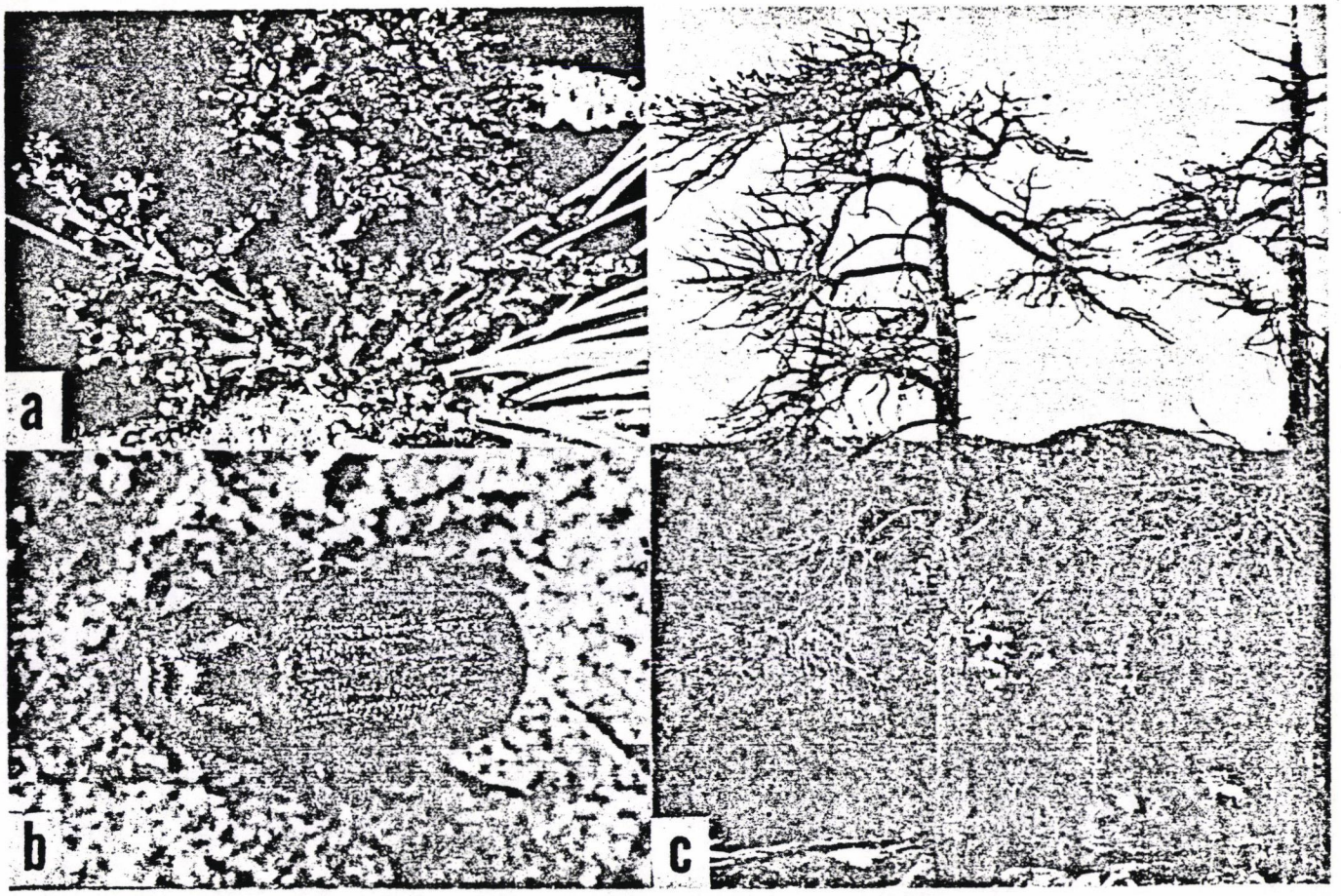
INTRODUCTION

As early as 1916, it was suggested that dwarf mistletoes may increase the susceptibility of ponderosa pines, Pinus ponderosa Laws., to attack by the western pine beetle, Dendroctonus brevicomis Leconte, and thus serve as epicenters for insect infestations (Miller and Keen, 1960). Several more recent reports have also implied that bark beetles may be attracted to dwarf mistletoe infected trees (Frye and Landis, 1975; Parker and Stipe, 1974; Scharpf, 1975; Stipe, 1975); however, little conclusive quantitative data have been presented to support the hypothesis.

The mountain pine beetle, D. ponderosae Hopkins, has been active in the Colorado Front Range for many years. Aerial surveys conducted during 1974-75 give some indication of recent ponderosa pine losses (Cahill, 1975). A precise estimate of currently infested trees is not available, however, at least one million trees were killed during 1974. The number of trees infested in 1975 probably exceeds 1.5 million based on build-up ratio surveys of old-to-newly attacked trees conducted during October 1975 (Johnson and Minnemeyer, 1976).

Epidemic tree mortality due to mountain pine beetle has been found as far south as Westcliffe, Colorado and as far north as the Colorado - Wyoming state line (see map - Appendix). Mortality occurs in small groups ranging from a few trees to larger groups of a few thousand trees. Vast acreages of overstocked, mature and dwarf mistletoe-infected ponderosa will probably ensure continuation of the epidemic (Cahill, 1975).

Since ponderosa pine dwarf mistletoe, Arceuthobium vaginatum subsp. cryptopodum (Engelm.) Hawks. and Wiens, is common throughout the area of the current mountain pine beetle epidemic (Figure), we decided to survey several stands to determine if dwarf mistletoe-infected trees are more susceptible to mountain pine beetle attack.



DWARF MISTLETOE AND MOUNTAIN PINE BEETLE CONTRIBUTE TO GROWTH LOSS AND MORTALITY OF PONDEROSA PINE IN THE COLORADO FRONT RANGE.

(a) Male and female plants of the southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *crytopodum*.

(b) Adult mountain pine beetle.

(c) Mountain pine beetle-killed pines on a poor site exhibiting extensive dwarf mistletoe infection.

OBJECTIVES

The major objective of this survey was to determine if ponderosa pine dwarf mistletoe predisposes trees to attack by the mountain pine beetle in the Colorado Front Range.

SURVEY PROCEDURE

Areas for survey were selected after consultation with co-workers who had knowledge of the location of mountain pine beetle and dwarf mistletoe-infested stands in the Colorado Front Range. Four separate areas, representing a range in stand conditions, mountain pine beetle infestation and dwarf mistletoe infection, were surveyed during 1976. Descriptions of the survey areas are included in Table 1. Maps of the areas are included in the Appendix.

Stand structure and species composition data were collected on variable radius plots (10 BAF) at five chain intervals. Live and currently infested ponderosa pines (5 inches d.b.h. and over) on each plot were rated for dwarf mistletoe infection (DMR) using Hawksworth's 6-class system (Hawksworth and Lusher, 1956). Current mountain pine beetle activity was also noted.

Strip plots, one chain wide, were taken between variable radius plots. Diameter at breast height (d.b.h.) and DMR were recorded for all beetle infested trees.

RESULTS AND CONCLUSIONS

Table 2 summarizes the stand data for each area surveyed. The percentage of trees per area infected with dwarf mistletoe ranged from 6.2 to 21.6 (Table 2). Numbers of trees per acre currently infested with mountain pine beetle ranged from 1.9 (Bailey) to 5.9 (Balman Reservoir). In two areas, Johnny Park and Balman Reservoir, the average DMR of beetle infested trees was higher than the average DMR of trees with dwarf mistletoe alone (Table 2). The percentage of trees infected with dwarf mistletoe, as determined by the green stand survey, was used to determine the expected percent of beetle-infested trees infected with dwarf mistletoe. This expected value was then compared to the actual number of beetle-infested trees infected with dwarf mistletoe using the chi-squared test. The results were as follows:

AREA	X^2 VALUE	df	SIGNIFICANCE
Little Scraggy	0.088	1	N.S.
Bailey	2.266	1	N.S.
Johnny Park	48.261	1	significant (P=0.01)
Balman Reservoir	69.430	1	significant (P=0.01)

Those areas where the average DMR of the stand was low showed no relationship between bark beetle attack and dwarf mistletoe infection. An additional test for determining a significant difference in the relative proportions of the "ordered classifications" (Snedecor and Cochran, 1974) of the DMR (using Hawksworth's 0-6 ranking as the basis for the ordered classification) showed a significant trend for the mountain pine beetle to infest dwarf mistletoe-infected trees of the higher DMR (x^2 = 1.853, 109 df, significant P=0.01) for the Johnny Park area. No significant trend was found for the other areas.

Survey data also indicated that the mountain pine beetle attacked the larger diameter trees in the stand. Average d.b.h. of infested trees ranged from 10.71 (Bailey) to 13.01 inches (Balman Reservoir). Basal area readings (which included live, dead and currently infested trees) taken in the vicinity of groups of currently infested trees ranged from 102 (Bailey) to 143 ft^2/acre (Balman Reservoir).

The results of this preliminary survey indicate that there may be a positive relationship between mountain pine beetle attraction to dwarf mistletoe-infected trees in portions of the Colorado Front Range; however, since only 86 acres were surveyed we feel that additional work is needed to define this relationship for other areas in the Front Range. It is interesting to note that the mountain pine beetle has been active in the Black Hills of South Dakota for many years despite the absence of dwarf mistletoes.

Management and pest control strategies of ponderosa pine stands in the Colorado Front Range are dependent upon an assessment of both mountain pine beetle and dwarf mistletoe. Areas for additional investigation include the interrelationship of dwarf mistletoe and mountain pine beetle under both endemic and epidemic levels of insect activity and brood production in dwarf mistletoe infected trees.

TABLE 1

DESCRIPTION OF AREAS SURVEYED FOR DWARF MISTLETOE AND MOUNTAIN PINE BEETLE DURING 1976

FOREST	DISTRICT	AREA	LEGAL DESCRIPTION	ELEVATION (FEET)	ACRES SURVEYED
Pike	South Platte	Little Scraggy Peak	T. 8 S., R. 70 W., Sec. 20, 29	7500 - 7750	17
Pike	South Platte	Bailey	T. 7 S., R. 72 W., Sec. 25, 36	8000 - 8200	24
Roosevelt	Boulder	Johnny Park	T. 3 N., R. 71 W., Sec. 2, 11	7600 - 8400	23
San Isabel	San Carlos	Balman Reservoir	T. 46 N., R. 11 E., Sec. 5, 6 7, 8	8700 - 9000	22

TABLE 2

SUMMARY OF STAND DATA FOR AREAS SURVEYED FOR DWARF MISTLETOE AND MOUNTAIN PINE BEETLE DURING 1976

Stand Character	SURVEY AREA			
	Little Scraggy	Bailey	Johnny Park	Balman Reservoir
live and dead PP/acre (no. of trees)	99.7	90.9	71.9	45.6
DM - infected PP (percent)	11.0	19.7	21.6	6.2
PP/acre currently infested w/MPB (no. of trees)	2.4	1.9	4.2	5.9
Ave. DM rating for DM infected trees	2.9	3.8	4.5	3.7
Ave. DM rating for MPB trees infected w/DM	2.8	3.2	5.0	4.2
Ave. d.b.h. of MPB infested trees (inches)	11.86	10.71	11.51	13.01
Ave. BA for trees in MPB groups (ft^2/acre)	128	102	127	143

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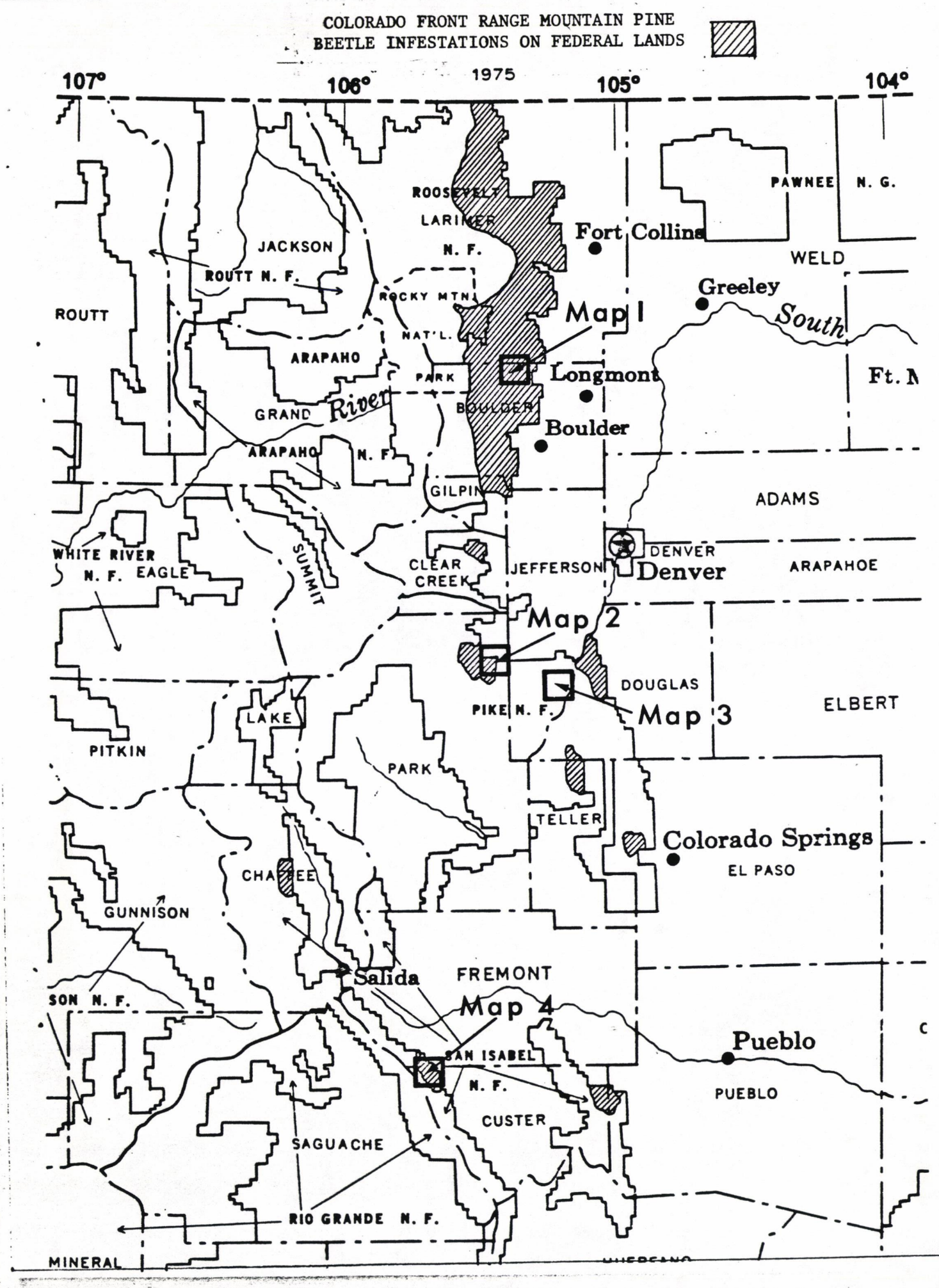
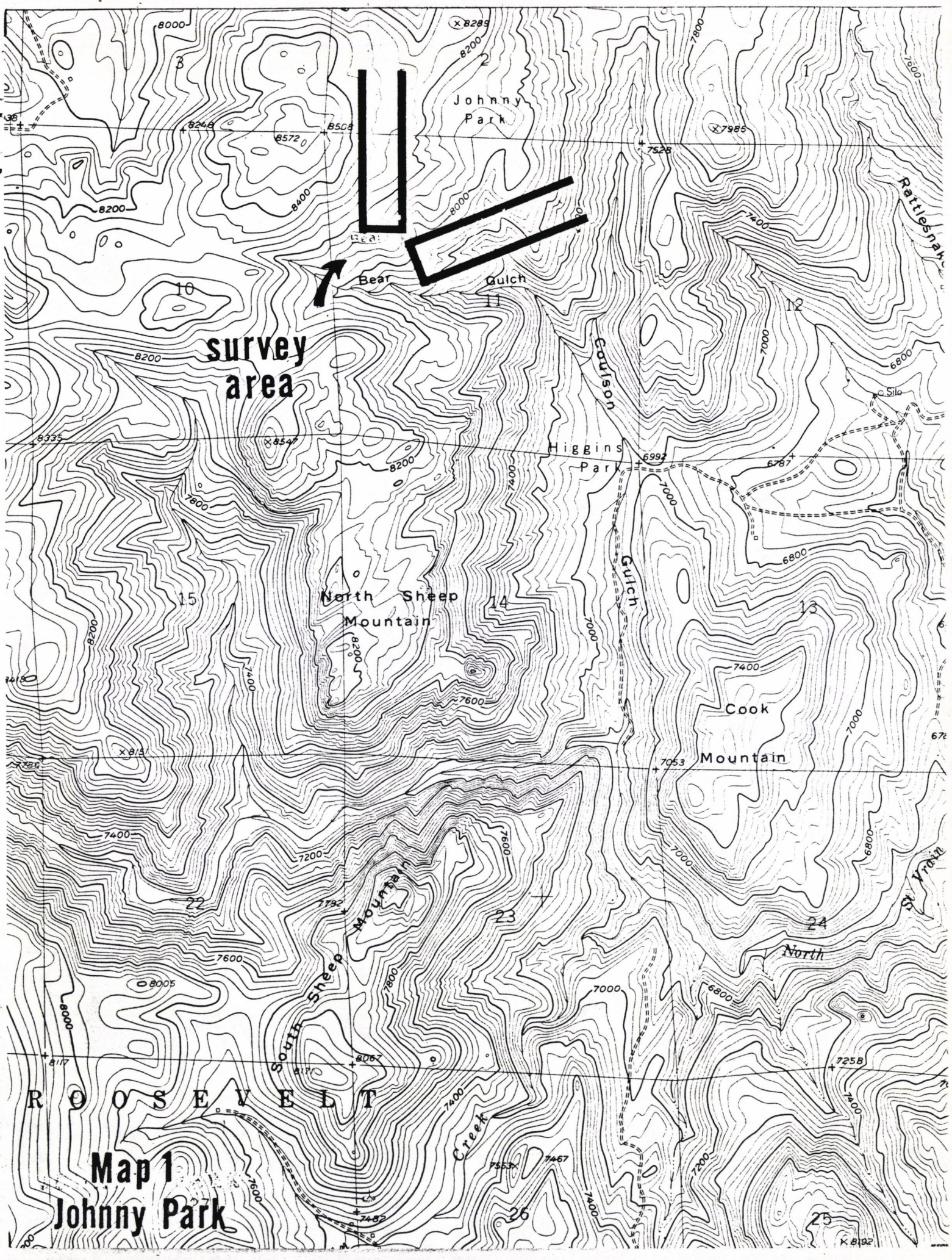
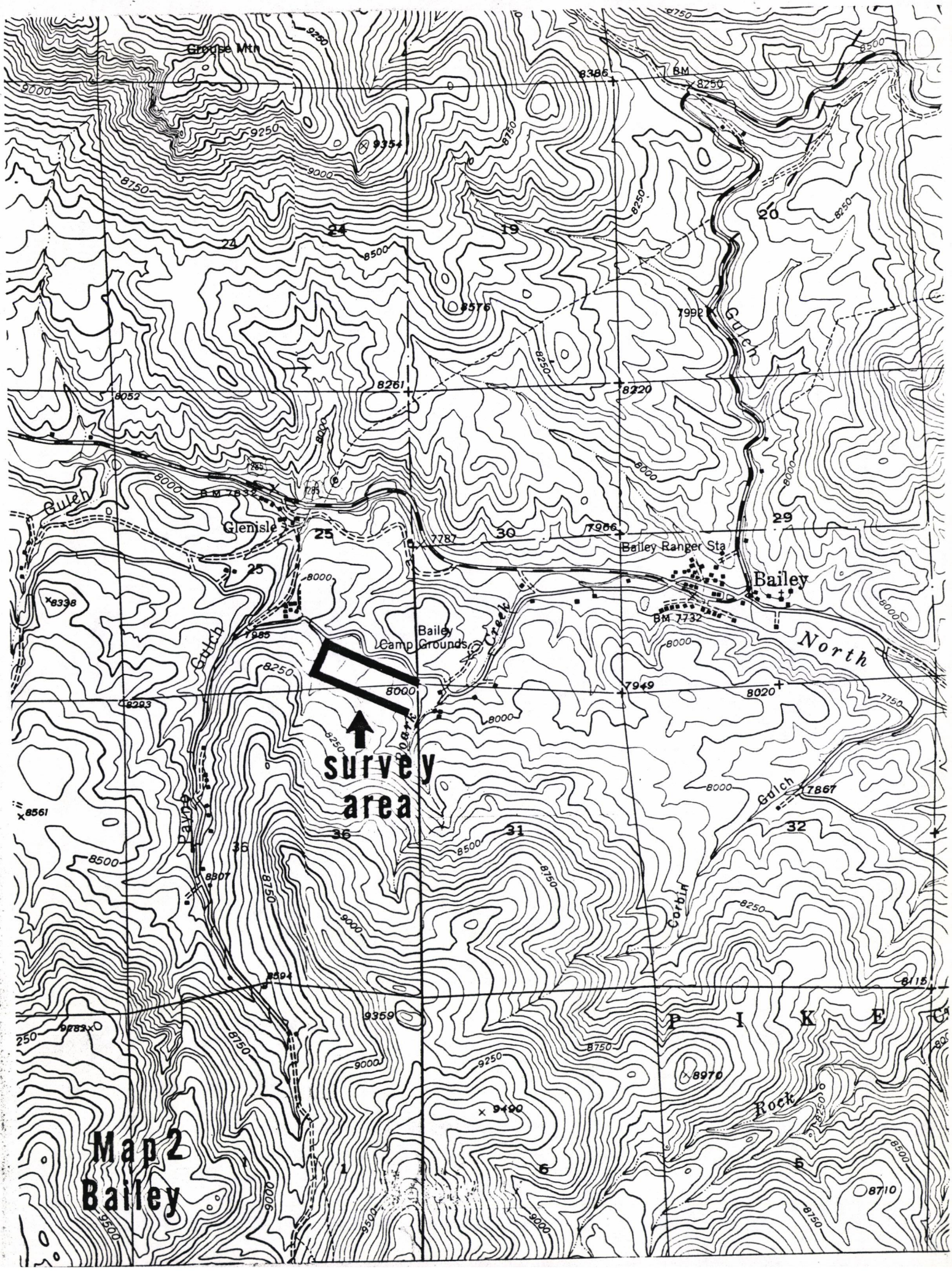
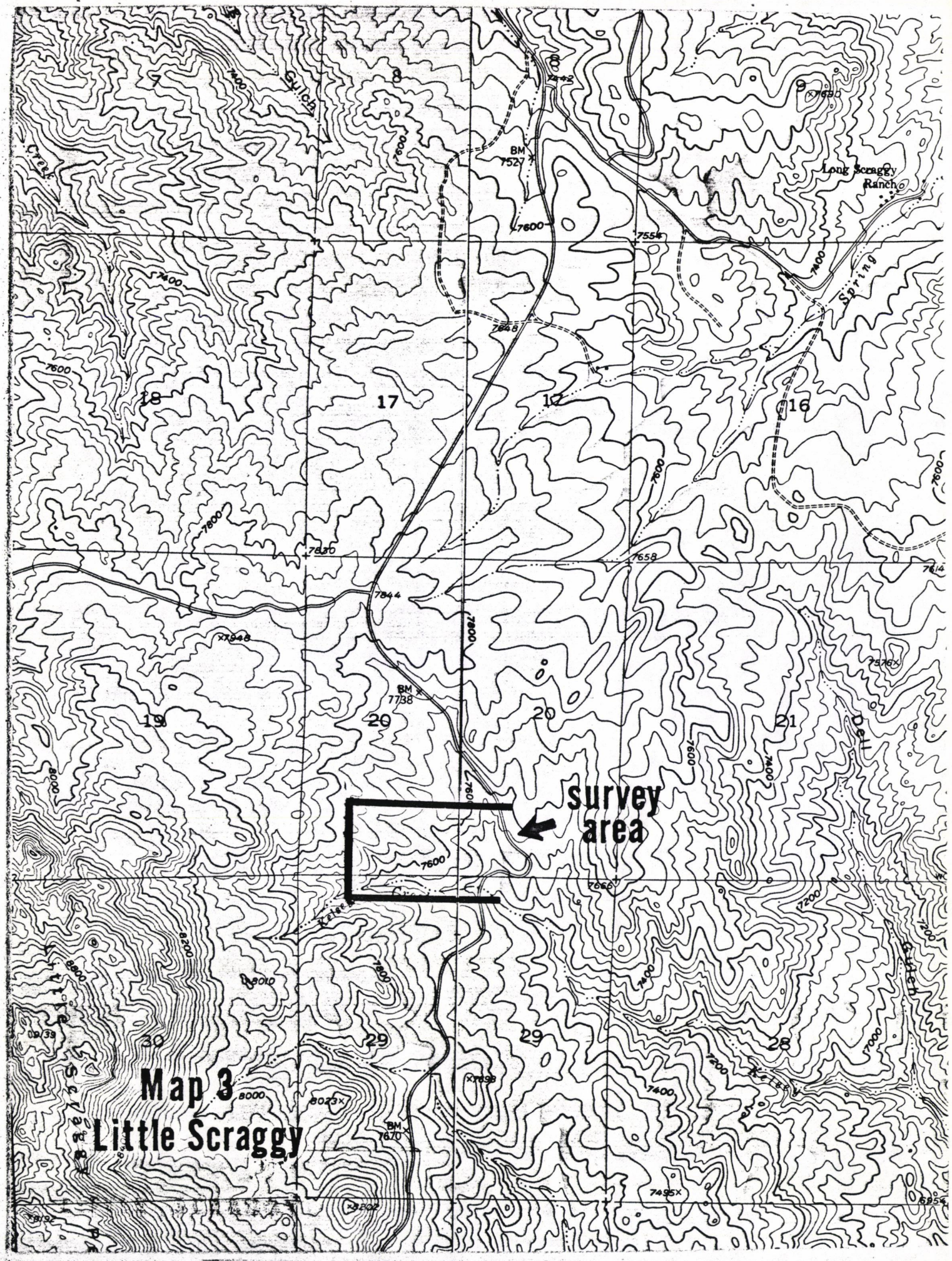
APPENDIX

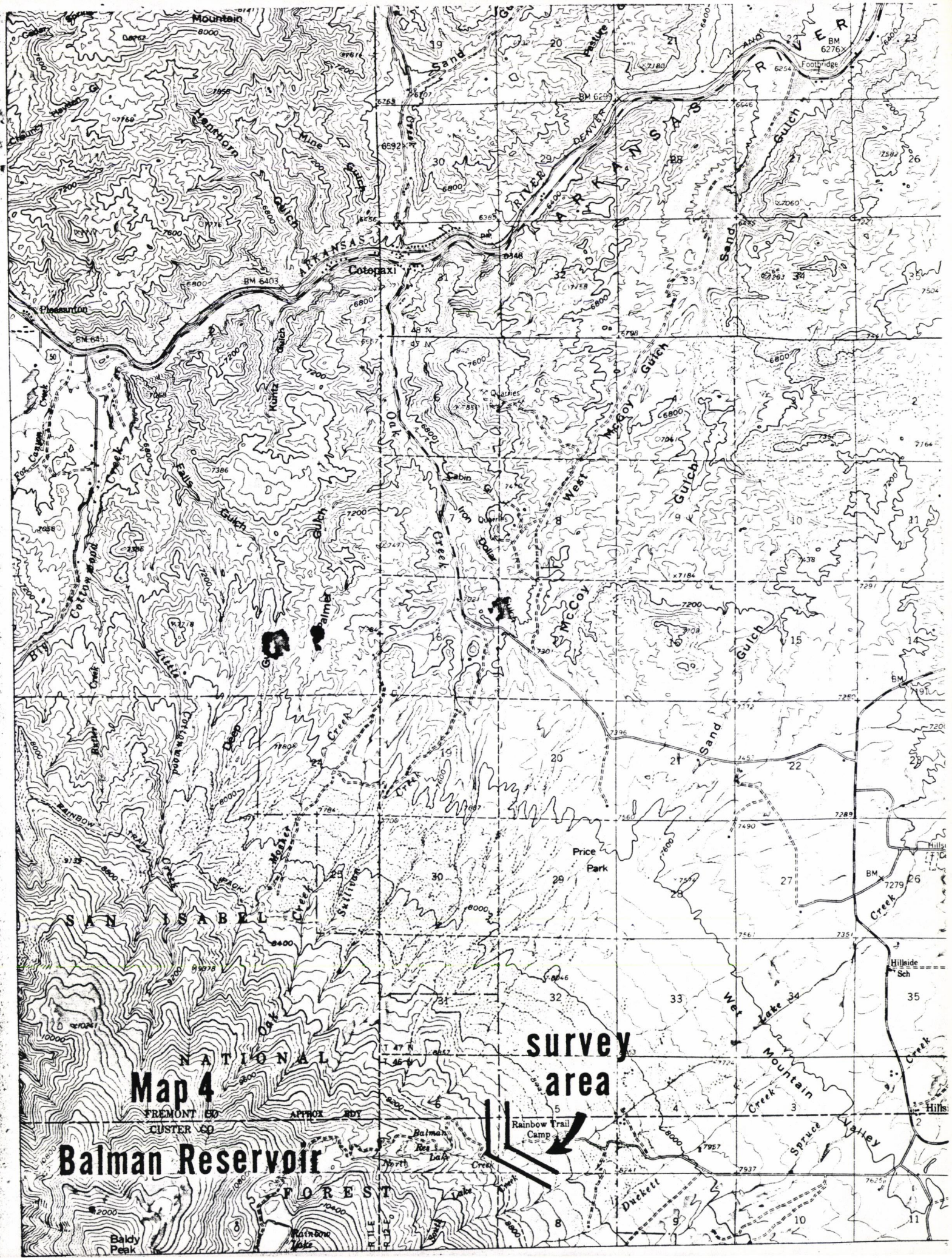

COLORADO FRONT RANGE MOUNTAIN PINE
BEETLE INFESTATIONS ON FEDERAL LANDS
1975
107°
106°
105°
104°
ROOSEVELT
LARIMER
N. F.
PAWNEE N. G.
Fort Collins
WELD
JACKSON
ROUTT N. F.
ROUTT
ROCKY MTN.
NAT'L.
Map 1
Greeley
South
ARAPAHO
PARK
Longmont
Ft. N
GRAND River
BOULDER
Boulder
ARAPAHO N. F.
GILPIN
ADAMS
WHITE RIVER
N. F.
EAGLE
SUMMIT
CLEAR
CREEK
JEFFERSON
DENVER
Denver
ARAPAHOE
Map 2
DOUGLAS
PIKE N. F.
Map 3
ELBERT
LAKE
PITKIN
PARK
TELLER
Colorado Springs
EL PASO
CHAFFEE
GUNNISON
Salida
FREMONT
Map 4
SON N. F.
Pueblo
SAN ISABEL
N. F.
PUEBLO
CUSTER
SAGUACHE
RIO GRANDE N. F.
MINERAL


survey area
Johnny Park
Bear Gulch
Coulson Gulch
Higgins Park
North Sheep Mountain
Cook Mountain
South Sheep Mountain
North Fork
ROOSEVELT
Creek
Rattlesnake
Silo
Map 1
Johnny Park


Grouse Mtn
9354
8386
BM 8250
8576
7992
Gulch
8261
8220
8052
BM 7832
Glenisle
7787
7986
Bailey Ranger Sta
Bailey
BM 7732
Bailey Camp Grounds
Creek
North
7949
8020
survey area
Gulch
7867
8561
8807
8594
9359
9283
8970
9490
8710
Rock
Corbin
Map 2
Bailey


survey area
Long Scraggy Ranch
Spring
Gulch
Little Scraggy
BM 7527
BM 7738
BM 7670
7600
7556
7658
7844
7830
7576
7656
7698
7495
8023
8010
8200
8000
7800
7400
7200
7000
6800
17
18
19
20
21
16
29
28
30

Map 3


survey area
Map 4
Balman Reservoir
SAN ISABEL NATIONAL FOREST
Cotopaxi
Pleasanton
Price Park
Rainbow Trail Camp
Balman Res
Rainbow Lake
Baldy Peak
Hillside Sch
Arkansas River
Sand Gulch
McCoy Gulch
Oak Creek
Deep Creek
Mosier Creek
Sullivan Creek
Spruce Valley
Mountain Creek
Duckett Creek
Rainbow Trail
T 48 N
T 47 N
T 46 W
FREMONT CO
CUSTER CO